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RADIATOR TRAPS AND TEST DATA

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The primary object of a steam trap is to actuate a valve in such a way as to permit all water or condensed steam to flow quietly out of the radiator and at the same time, to allow none of the steam to escape with it. It will be seen that, to keep the radiator well cleared of water, the valve must operate very often. It is therefore subject to more or less wear. In the main, two general principles are employed, namely, the float and the thermostat. In the float type the valve is simply part of a hollow vessel and is lifted and opened by the water collecting under it. When this water runs away the valve, of course, settles to its seat.

The thermostatic valve is actuated by the contraction and expansion of metals or gases due to heat. When the thermostat is surrounded by water, it is naturally cooler than when in contact with steam with the result that the element shortens and opens the valve.

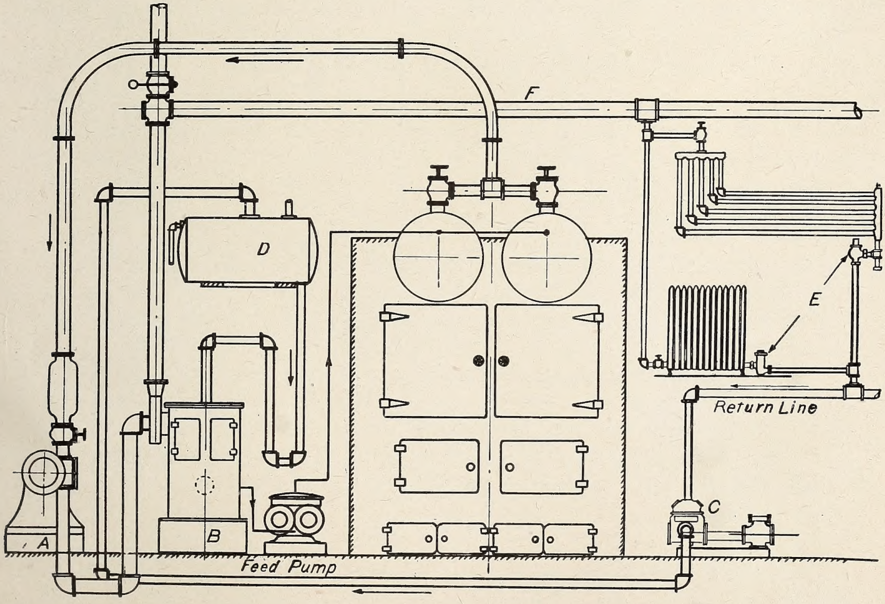

Fig. 1. Outline of Vacuum Heating Plant, Illustrating the use of Radiator Traps

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Fig. 1 illustrates the common method of using radiator traps in connection with a vacuum heating system. Live steam from the boilers is used to drive the engine indicated at A. Exhaust steam from the engine is taken to the feed water heater B where approximately 1-7 of the heat units in it may be used to heat the feed water for the boilers from a temperature of say, 50° to 210° F., and the remaining 6-7 will thus be available for the heating system. This exhaust steam at low pressure is led directly to the radiators, and a vacuum is pumped on the return lines of the system by the vacuum pump C. The pump discharges the condensed steam into the tank D, from which it flows by gravity to the feed water heater B. After being heated to the temperature of 210° or 212° F. in the heater, it completes the circuit by being returned to the boilers by the feed pump.

In a heating system of this kind we might operate the plant with a steam pressure of from 0 to 5 pounds per sq. inch on the pipe F, and with a vacuum of from 8 to 10 inches on the return line, these values of course depending on the number of square feet of heating surface being supplied and the distance the steam has to be carried.

It is clear that under these conditions steam would blow through the radiator without being condensed and giving up its latent heat, unless some provision was made to prevent it. To stop this waste of steam, traps are placed on the return ends of the radiators as shown at E

In order to test the comparative efficiencies of several well-known makes of radiator traps the apparatus shown in Fig. 2 was fitted up in the Thermodynamic Laboratory of the University of Toronto.

Description of Apparatus

The apparatus consists essentially of a standard type of radiator having 60 square feet of radiating surface and which is connected to the steam pipes in the same way as when set up for actual service. A mercury manometer is attached to the inlet pipe to register the pressure of the steam entering the radiator, while a thermometer in the same pipe can be used to indicate the temperature when desired. To the outlet pipe is attached a radiator trap E, a tank B, in which is collected the condensed steam from the radiator, a glass condensing coil, and a glass jar A, which condenses and collects any steam that may pass the trap.

There is an advantage in having the condensing coil and jar A of glass, as, during the test, the rate at which the steam is passing the trap may be noted and the completeness of condensation verified. The desired vacuum was indicated on gauge C, and was obtained by connecting the apparatus to a vacuum pump as shown.

Object of Test

(a)—To determine whether the traps performed their main function, namely, that of allowing all water of condensation to pass from the radiator without letting steam pass as well.

(b)—To determine the temperature efficiency of radiator.

(c)—To determine whether all air was removed from the radiator by the trap.

(d)—To determine whether the traps performed their functions without noise.

Method of Making Tests

Before starting the tests, steam was turned on the radiation and the system allowed to heat up to its normal working condition; after this, readings of temperatures and pressures were taken at intervals of ten minutes for a period of two hours. If any water had collected in the radiator during the test it was drawn off and weighed.

By referring to Fig. 2, it will be seen that tanks A and B are so connected that they are always under the same vacuum of pressure, the water-leg preventing steam from passing to the tank B, therefore, if any steam passes the trap, it will find its way to the condensing coil and from there to the tank A. The weight of water in B represents the steam condensed in the radiator, while the water in A, after the proper correction has been made, represents the steam that has passed the trap.

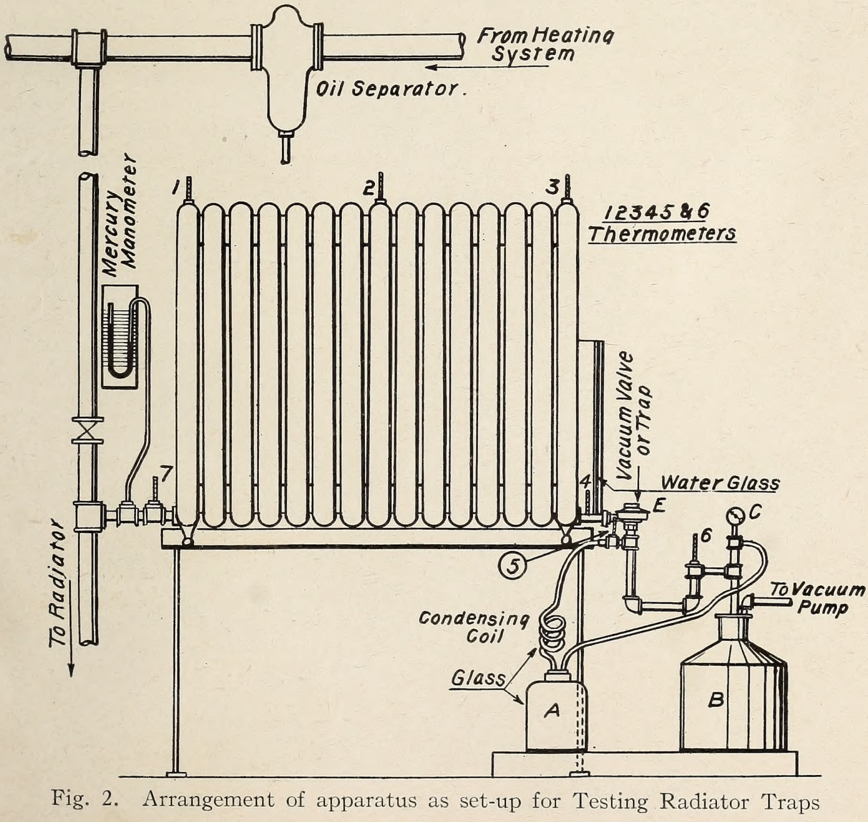


Fig. 2. Arrangement of apparatus as set-up for Testing Radiator Traps

Method of Computing Results

In order to get the true value of the steam passing the trap a correction must be made to the quantity caught in tank A, because a certain amount of the water in the radiator which would remain as water while under the pressure in radiator would burst into steam after passing to the lower pressure beyond the trap. The following method will give a close approximation to what this correction should be.

Let A = the number of pounds of water caught in tank A.

Let B = the number of pounds of water caught in tank B.

Let r = the heat of vaporization of one pound of saturated steam under vacuum.

Let X = temperature of water at thermometer No. 4.

Let Y = temperature of steam corresponding to vacuum.

Let C = correction, i.e., the number of pounds of water to be deducted from A.

Let E = net weight of steam passing trap.

$$\text{Then } C = \frac{(X-Y)}{r} \times B \text{ and } E = A - C.$$

The above correction, while not exact, is quite close enough for practical purposes, and as it has been applied to each valve tested, the comparison should be fair.

The temperature efficiency of the radiator is defined as the average temperature of the radiator divided by the temperature of saturated steam corresponding to the pressure in the radiator. The temperature efficiency gives a very good indication of the quantity

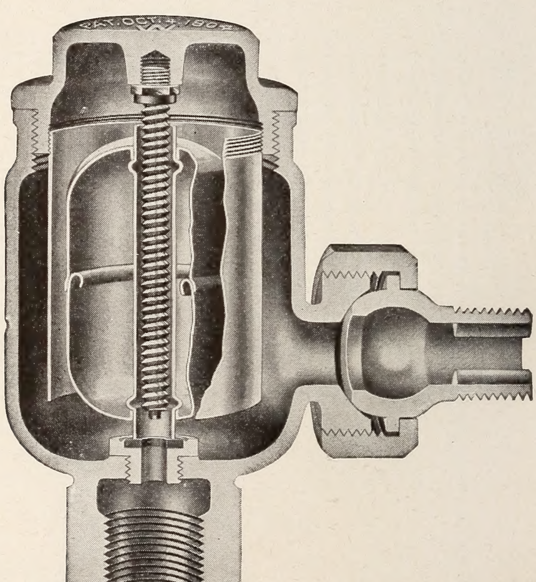


Fig. 3. Webster Water Seal Motor Trap—Float Type

of air being trapped and held in the radiator sections. For instance, if the temperatures as read from thermometers 1, 2 and 3, Fig. 2, are nearly equal, and not far below that corresponding to the steam pressure, it shows that steam is filling each section and therefore air must be absent. In the following tabulation the first test is given complete; in the others, only the minimum, maximum and average values are given for the pressures and temperatures, and the final results. Particulars of the traps tested are as follows:

Webster Water Seal Motor

This trap, Fig. 3, operates on the float principle. As shown in the figure, it consists of a metal shell in which a float fits loosely. The float is made of pressed steel with a hollow tube passing through its centre, a spiral screw fastened to the valve cover serving as a guide for the float. The air discharge is down through the hollow tube in the float which connects directly with the return line. When the water (which will rise higher in the valve than in the radiator due to the vacuum) reaches a certain height, the float rises and allows the water to be discharged.

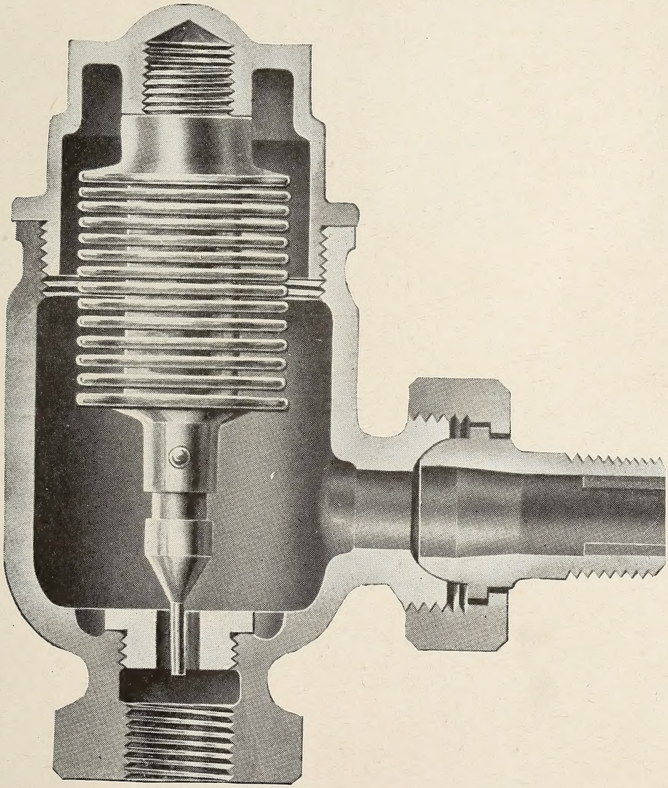


Fig. 4. Webster Sylphon Trap—Thermostatic Type

Webster Sylphon Trap

This trap, shown in Fig. 4, operates on the thermostatic principle. Most traps which depend for their action on this principle, have an expanding member, one end of which is fixed firmly to the cover of the valve chamber, while the other end carries the valve. This expanding member is usually hollow and contains a volatile fluid which readily changes to the form of gas when its temperature is slightly increased. Suppose the valve in the trap closed. Water will begin to accumulate and its temperature will fall slightly. This drop in temperature causes the expanding member to contract which opens the valve to discharge water. As the water flows out, it becomes warmer and this allows the valve to close slightly and reduces the flow.

As shown by the results of these tests, a radiator trap made on this principle may be adjusted to work very satisfactorily. By referring to Fig. 4, it will be seen that the expanding member in the Webster Sylphon Trap is a hollow brass spiral coil one end of which is attached to the cover and the other to the valve stem. The body of the valve is of cast iron and the valve and stem of brass. The valve itself is cone shaped.

D. G. C. Trap

This trap, a section of which is shown in Fig. 5, operates on a different principle from any thus far described. The steam passing through the screen at the right of the figure, reaches the rectangular chamber adjacent. A small, circular opening connects this chamber with the valve chamber directly below, and, through this opening, all water and air must pass.

The valve consists of a small circular disc of brass with a stem

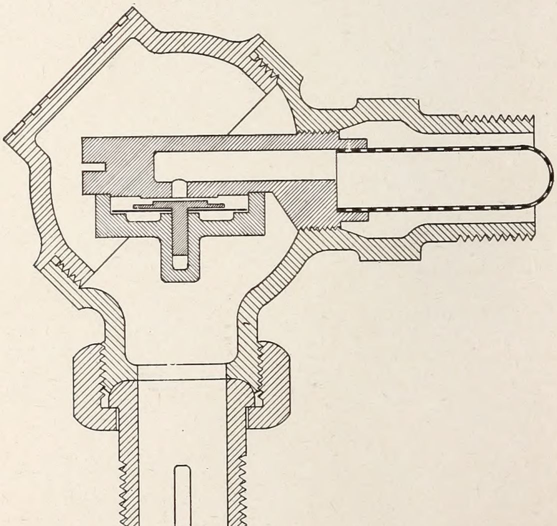


Fig. 5. D.G.C. Trap—Difference in Pressure Type

attached to the under side to act as a guide. If steam passes through this small orifice, its velocity is increased, and this high velocity steam blowing down on top of the valve disc, creates an area of low pressure above it. The disc rises and closes the opening as soon as the pressure under it becomes greater than that above it.

Hains or "Vento" Trap

A cross section of this trap is shown in Fig. 6. The operating member which closes or opens the valve is a U tube which is hollow, and is filled with a volatile fluid. When the pressure in the tube increases, due to the increase in temperature, the prongs of the tube spread and close the valve. When the temperature falls, the prongs come together and thus open the valve. The body of the trap is of cast iron, while the U tube and valve are of brass.

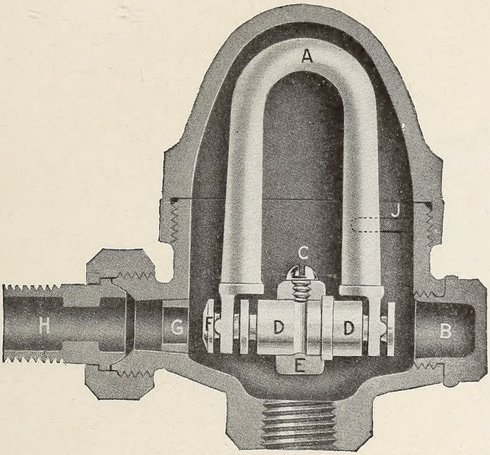


Fig. 6. Hains or "Vento" Trap—Thermostatic Type

"Welo" Radiator Trap

This trap is shown in cross section in Fig. 7. It also operates on the thermostatic principle. The receptacle for the expansive fluid is a corrugated copper tube and, to this tube or cartridge is attached the valve. If steam comes in contact with the corrugated tube, it expands until the valve is closed. When sufficient water has collected to reduce the temperature slightly, the valve opens to discharge the water and air. The corrugated tube is of copper and the rest of the trap is made of seamless bronze.

No. 8 Sarco Steam Trap

By referring to Fig. 8, it will be seen that this trap is in form very much like the "Welo," which has just been described and that it also works on the thermostatic principle. The main difference is that, in this trap, the expansive fluid surrounds the corrugated tube to which the valve is attached and is not within the tube as in the

case of the "Welo." The body of the "Sarco" trap is of steel and the expansion member is made of copper.

"Marsh" Reflux Trap

As seen from Fig. 9, this trap operates on the thermostatic principle, the hollow corrugated disc containing the expansive fluid is inserted between the valve and a hollow stem fixed to the top of the cover. The action is the same as in other types of thermostatic valve described.

"Durham" No. 1 Radiator Trap

From Fig. 10 the method of operation of this trap is clear. The expansion member is a hollow corrugated disc which contains the

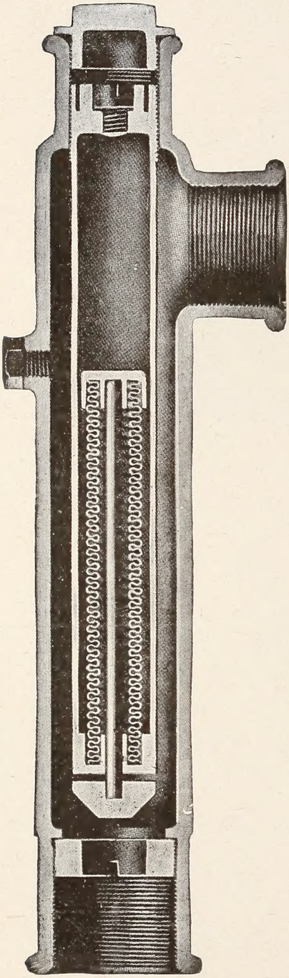


Fig. 8. Sarco Steam Trap—Thermostatic Type

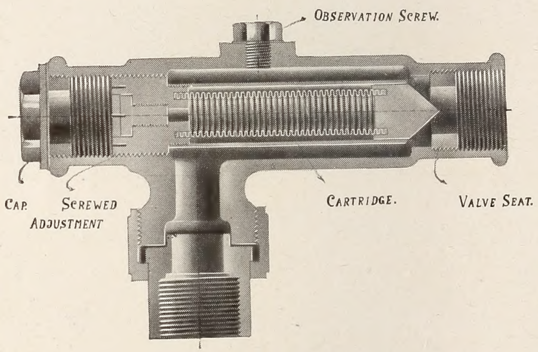


Fig. 7. The "Welo" Radiator Trap—Thermostatic Type

volatile fluid. One side of this disc is fastened to the cover, while the other side carries the valve. A slight variation of temperature inside the trap will cause the valve to open or close. The hollow disc is made of copper and the body of the trap of brass.

Purpose of Tests

These tests were made primarily for the purpose of satisfying the writer as to the value of radiator traps, which he has had occasion to specify at different times in connection with the design of low pressure heating systems. Numerous inquiries along this line from architects and heating engineers would indicate that the question is a live one with all men directly interested, and seems to justify the publication of the results of this somewhat exhaustive test.

It must be remembered that there are other important features

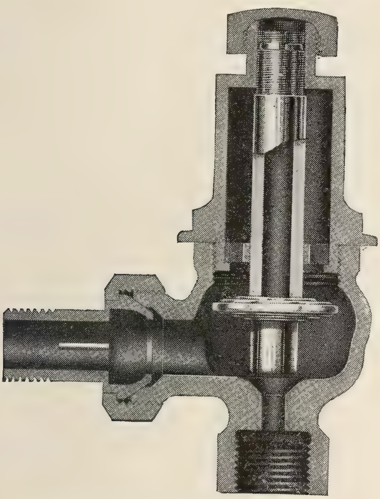


Fig. 9. Marsh Reflex Trap—Thermostatic Type

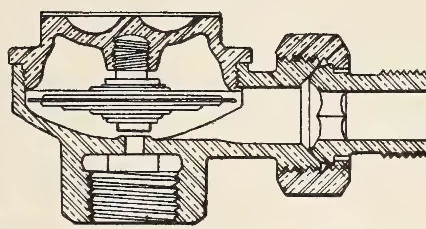


Fig. 10. Dunham No. 1 Radiator Trap—Thermostatic Type

connected with radiator traps which cannot be decided by laboratory tests, for example, mechanical construction on which depends the life of the valve and its seat. The lift of the valve from its seat and the shape of both valve and seat determine its likelihood to clog on account of scale or dirt coming from the radiator. The ease with which the traps may be cleaned and kept in running order is also a very important feature. Mechanical knowledge and good judgment on the part of the purchaser should enable him to choose the best trap from a mechanical standpoint, but the length of life and other such questions can only be determined by comparing the action of traps operating over long periods of time under similar conditions.

The writer wishes to acknowledge suggestions and help given by Professor R. W. Angus, of the Department of Mechanical Engineering of the University of Toronto, and also the hearty co-operation of the manufacturers who furnished the traps tested.

No. of test	Values given	Time	Pressure: Inches Mercury	Pressure: Inches Vacuum	Temperatures: 1	2	3	4	5	6	Room	Name and type of trap	Aver. temp. of radiator	Temp. efficiency of radiator	Steam condensed in radiator	Lbs. of steam passed by trap	% of steam passed by trap
2	Min.	10.11	2.7	9.0	214.0	215.0	213.0	212.0	182.0	180.0	**100.0**	*Webster	....	....	....	....	....
	Max.	to	3.8	9.0	216.0	217.0	215.5	215.0	191.0	187.0	**106.0**	Sylphon	....	....	....	....	....
	Aver.	12.11	3.05	9.0	215.0	215.6	214.4	213.8	188.5	185.0	**102.0**	Trap	**215.0**	99.1	38.5	0.00	....
4	Min.	10.40	2.70	9.0	214.0	215.0	214.5	215.0	183.0	190.0	....	*D. G. C.	....	....	....	....	....
	Max.	to	3.10	10.5	215.0	216.0	215.0	216.0	194.0	198.0	....	Disc	....	....	....	....	....
	Aver.	12.40	2.92	9.6	214.6	215.5	215.0	215.7	190.6	194.0	....	Trap	**215.0**	99.2	43.5	0.54	1.22
5	Min.	20.8	2.70	10.0	213.5	214.5	214.0	214.5	189.0	192.0	**98.0**	*"Vento"	....	....	....	....	....
	Max.	to	3.30	10.0	215.0	215.0	215.0	215.0	190.0	193.0	**110.0**	Ther'static	....	....	....	....	....
	Aver.	40.8	2.96	10.0	214.0	215.0	214.2	215.2	189.7	192.4	**107.0**	Trap	**214.4**	98.94	46.5	0.58	1.21
6	Min.	15.5	2.10	9.0	213.0	214.0	213.0	212.0	186.0	182.0	**106.0**	*"Welo"	....	....	....	....	....
	Max.	to	4.20	10.0	217.0	217.5	217.0	215.0	189.0	183.0	**107.0**	Low press.	....	....	....	....	....
	Aver.	3.55	3.03	9.16	214.7	215.4	214.6	212.5	188.5	182.0	**106.7**	Trap	**214.9**	99.1	36.0	0.00	....
7	Min.	10.29	4.50	8.00	217.0	218.0	216.0	207.0	172.0	173.0	**95.0**	"Sacro"	....	....	....	....	....
	Max.	to	4.60	10.00	217.5	218.25	217.0	217.25	194.0	197.0	**101.0**	*..........	....	....	....	....	....
	Aver.	12.29	4.54	9.32	217.3	218.10	216.9	214.5	181.0	180.2	**99.0**	....	**217.4**	99.2	41.0	0.25	0.6
8	Min.	2.25	3.1	7.5	215.0	215.0	214.5	215.0	191.0	183.0	**97.0**	Marsh	....	....	....	....	....
	Max.	to	5.6	9.5	219.0	220.0	219.0	219.0	192.0	188.0	**104.0**	*Reflex	....	....	....	....	....
	Aver.	4.25	5.08	9.1	218.1	219.1	218.2	217.5	191.8	186.0	**101.4**	....	**218.5**	99.3	39.5	0.03	....
9	Min.	10.12	3.9	9.0	217.5	217.0	215.6	216.0	180.0	176.0	**75.0**	*Dunham	....	....	....	....	....
	Max.	10.12	4.0	10.5	217.5	217.0	216.0	216.0	184.0	190.0	**79.0**	No. 1 Radiator	....	....	....	....	....
	Aver.	10.12	4.0	10.0	217.5	217.0	215.8	216.0	182.0	187.5	**76.0**	Trap	**216.8**	99.2	39.1	0.00	....

*All the traps tested operated without noise, and none of them allowed air or water to gather in the radiator.

Log Sheet of Complete Data Taken in Leading Test No. 1

Time p.m.	Steam pressure Inches of mercury	Vacuum inches	Temperatures in Degrees F. 1	2	3	4	5	6
2.48								
2.50	2.2	10.0	214.0	214.5	214.0	214.0	187.0	190.0
3.00	2.2	10.0	214.0	214.5	214.0	214.0	189.0	192.0
3.10	2.2	10.0	214.0	214.5	214.0	214.5	190.0	192.0
3.20	2.1	10.0	213.5	214.5	214.0	215.0	191.0	193.0
3.30	2.1	9.5	213.5	214.5	214.0	214.5	190.0	192.0
3.40	2.1	10.0	213.5	214.5	214.0	214.5	191.0	193.0
3.55	2.1	10.0	213.5	214.5	214.0	214.0	189.0	191.0
4.05	2.1	10.0	214.0	214.5	214.0	214.5	190.0	191.5
4.15	2.4	10.0	214.5	215.0	214.0	215.0	190.0	192.0
4.25	2.5	10.0	214.0	215.0	214.5	215.0	190.0	193.0
4.35	2.5	10.0	214.0	215.0	214.5	215.0	190.5	193.0
4.45	2.5	9.5	214.0	215.0	214.5	215.0	191.0	193.0
4.48	2.5	10.0	214.0	215.0	214.5	215.0	191.0	193.0
Average values	2.27	9.9	213.9	214.6	214.1	214.6	190.0	192.0

Total period of test = 2 hours.

Average temperature of radiator.. =214.2

Temperature corresponding to pressure in radiator........................ =215.6

Temperature efficiency of radiator.. = 99.3

Name of Trap..................Webster Water seal motor.

Steam condensed in radiator.. = 38.5 lbs.

Steam passed by trap.. = 0.61 lbs. = 1.58%

No air or water collected in radiator.

Operation of trap noiseless.

EDITOR :—It might be well to point out, that in comparing the various foregoing traps on the basis of the results of this experiment shown on page 92, their efficiency and the amount of water condensed is a function of the room and radiator temperatures. Therefore to get an accurate conception of each trap, the result as set out in the four columns to the right, should be modified by consulting the corresponding room and radiator temperature.

J. T. Mogan, B.A.Sc., '15, is on the Toronto Harbor Commission work.

J. M. Muir, B.A.Sc., '15, is with the department of education, Toronto.

Prof. C. R. Young, '03, and **H. H. Madill,** '11, have taken their captaincy papers at Niagara.

Wm. A. O'Flynn, B.A.Sc., '11, has accepted a position as 2nd chemist for the Mond Nickel Co., Coniston, Ont.

H. M. Peck, B.A.Sc., '15, is on geological survey work along east coast of James Bay.

H. A. Ricker, B.A.Sc., '08. Residence, 93 Sanford Ave. S., Hamilton.

C. C. Rance, B.A.Sc., '15, is with Canadian Inspection Co., Toronto.

A. A. Richardson, B.A.Sc., '15, is with the city engineer of Peterboro.

A. C. Ross, B.A.Sc., '15, is with the Canadian Inspection Co., Toronto.

M. L. Smith, B.A.Sc., '11, formerly associate editor for MacLean Publishing Co., Toronto, has accepted the position in charge of engineering at the New Technical School, Toronto.

MINOR DETAILS IN THE ENGINEER'S CAREER

By J. H. Kennedy, C.E., O.L.S., '82

In selecting this subject for a few remarks the author has endeavored to recall the time when he left the halls of the old School, and consider what he now believes after years of experience would have been most useful to him at that time; and it has occurred to him that a few rambling remarks along the line of posting the students and young graduates upon the snags they are liable to encounter, would be a fitting subject for one, who, if not the first graduate of the old School, believes himself to be the first to reach the chloroforming age in active work. The details proposed to be discussed are not called minor because they are of little importance, but because they are unseen when leaving school and their presence unknown until they become snags to progress. The young graduate looking through his mental telescope sees himself about to cut a wide swath with a clear blue sky line, through the world up the hill of fame, and it may be fortune, with the expectation of reaching heights and depths as yet unexplored. This is perfectly right and proper, and no fault is to be found with it. May it ever be so. Engineers must be men, of broad vision and optimistic, if they are to succeed. However, the time will come to each when he will reverse his mental telescope and view as a back sight what he had so fondly looked forward to as a foresight. The present paper is an attempt to point out a few of the minor obstructions to view while they are still foresights so they may not obstruct the backsight along the narrow and crooked traverse line that so many of us follow. If successful it will be of more real value to those for whom it is written than anything that can be said along the line of description of actual construction as followed by the usual methods, so well known to the profession. Now the first jolt the young graduate receives is when he realizes that the world instead of anxiously waiting for him to emerge from the college with the latest ideas and abstruse mathematical formulae will have nothing to do with him, except as a subordinate, because he has no practical experience in actual work. So he learns for the first time that the industrial world is very slow to give him credit for knowing how to do anything until after he has done it.

He learns that no capitalist will furnish the funds for any purely theoretical man without practical experience, to experiment with; so the only possible opening for him may be a position as rodman or instrument man. This instead of being a hardship will be a great benefit to him as it will give him an opportunity not only to see work in progress, but to learn ways and means, cause and effect; also an acquaintance with the men associated with actual work, and their methods of conducting work. He should learn from his own and other mistakes as well as from their successes. While thus employed his field notes will need considerable attention. Here is where many otherwise good men fall down. It is a notorious fact that the average instrument man that applies for such work today

is a nuisance to all concerned. Not only does he keep incomplete notes; but he fails to date, sign, or index his book, or record what his notes refer to, in such a way that his book will be understood by his successor. Such notes may not lead to discharge, but are most certain to prevent re-employment. For the above reason every young engineer should paste this in his hat. No railway or other company will keep a man on its engineering staff as an expert to explain his own notes; and his field notes may be his best recommend or his condemnation, whether he knows it or not. Field notes have turned down many otherwise good men in the past and will continue to do so in the future, notwithstanding all that can be said along this line.

Those of your readers who have had the good fortune to pass their college course under the tuition of our late Dean Galbraith, will recollect that he always urged his class to form the habit of keeping a diary for reference, for details of every day occurrences, sketches, etc. The author has kept such a diary since the spring of 1882 and would heartliy recommend it to all. One cannot remember details. Memory is treacherous, besides you may be a witness at some time when your diary will be better than the other man's memory. Some years ago Smith and Jones, two college graduates, but not of the old S.P.S., and that wasn't their names, were placed upon adjoining sections of railway grade, as assistant engineers. Their work was separated by a stream over which was to be erected an important bridge. After the grading work was well along and the bridge was to be staked out and superintended, it was decided to give the work to Smith as the better man. In fact Jones was not considered a safe man to depend upon. Though Smith could quite easily have taken this work along with his present work he refused on the ground that he already had more and more difficult work than Jones and as Jones received the same salary he considered it unfair to him. The consequence was that a new man Brown was employed for the bridge work; and as Brown proved a good man, he was retained and given what remained of Smith's and Jones' work, when it became necessary to reduce the staff. Now Smith's mistake was that he did not see that Jones' unfitness was his opportunity. Though they received the same salary he was forging ahead, while Jones' slipshod work was finding him out. Through his fear that he might be called upon to do something for nothing, Smith lost his best opportunity for advancement. His superior officer was the best judge as to whether he could handle the work and the fact that it was offered to him was evidence that his worth was appreciated, as well as to the fact that he was not overworked. Young man do not fail to recognize that after you have worked for a time upon the engineering staff of any corporation, your whole stock in trade, outside the few dollars you have earned, may be bound up in the estimate your superior officer has formed of your worth, and others know or care very little about you. Now that opinion is not necessarily formed by your scholarship alone it is just as much your accuracy in details, your industry, reliability and general make up. It is his recommend

that helps you to a higher position in at least nine cases out of ten; and the tenth comes to you because it is known that you have been in his employment. The fact that Jones received the same salary as Smith was no argument for Smith, as he received no less on that account. For illustration we may take another case in which Mr. Jones is an assistant engineer with a good C. P. Ry. record behind him and Smith a recent graduate of an Eastern college, is sent to him as rodman or instrument man, upon rough sidehill work. After a short time together in which they did not agree very well, Smith left his work and came to the writer with a tale of woe in which he claimed that Mr. Jones did not understand how to stake or calculate his work; and moreover Mr. Jones had left his work in his, Smith's charge, for some time and gone out on other business, so he was afraid he was doing all the work and Mr. Jones would get all the credit for it. Now where was this man to get the credit from if not from Mr. Jones himself. His eyes had not been opened to the fact that the niceties of the higher mathematics when applied to the necessarily rough work on the mountain side become absurdities. No college training in the higher mathematics will compensate for a lack of common horse sense. Leaving out of consideration the over estimate of his own importance, which Smith will soon outgrow, he was not loyal to Mr. Jones as he should have been. The soreheads of the engineering profession today are largely those who believe they have done the work of their superior officers or have furnished the brains and their abilities have not been recognized by the powers that be. This will always be the case for obvious reasons. It is not here argued that employers and Chief Engineers are always above criticism, being human like other people. Nor is it to be understood that the young graduate is in duty bound to take what he gets and be thankful that he gets anything whether it be much or little. What is claimed however, is that the salary received when making a start in the engineering world should not loom up to unduly large proportions to obscure other advantages in the way of receiving practical experience. It is experience that counts in the employer's opinion and your college training gives the power to turn that experience to your best advantage. May it aid you through the crowded ranks to a place at the top where there is said to be plenty of room.

MERCURY

In these days of experiment, most mechanical men have more or less to do with mercury. Being an elementary substance, it might be supposed that the nature of the metal would prevent it from being adulterated. However, this is not the case.

Mercury is an expensive substance and is frequently adulterated with lead, tin and other inexpensive metals that can readily be dissolved in it without very greatly affecting its fluidity. Such manipulations spoil mercury for experimental purposes and it is well to make a simple test for detecting any foreign matter. Put a drop of the metal on a plate of glass and roll it around. Pure mercury leaves no trace and rolls in spherical globules, while the adulterated mercury forms elongated tears covered with a gray pellicle which adheres to the surface.

NEW TYGARD ENGINES FOR IMPROVING SUBMARINE SERVICE

James W. Tygard

The Secretary of the United States Navy, Josephus Daniels, is making every effort to increase the efficiency of the submarine, and the Tygard Engine presents a new plan by which the great difficulties, due to the impure air discharged from the storage batteries, used in propelling the submarine when submerged, are removed.

Present System

In the present system while the submarine is not submerged, Deisel engines are used to compress air for the use of the crew and for the propulsion of the torpedoes from the tubes of the submarine.

The Deisel engines also generate electricity which is stored in a heavy and bulky system of batteries; the electricity being used later when the boat is submerged to drive its propelling screw by means of an electric motor.

This present method is a heavy, cumbersome, power-wasting system, and has the very great disadvantage of having the air, which the crew is forced to breathe, contaminated with the noxious gases that are continuously discharged while the storage batteries are in operation.

New Method

By the new system, the Tygard double-acting oil engine is used to compress air under high pressure in a system of steel bottles or reservoirs, which occupy some of the space formerly occupied by the storage batteries that are now rendered unnecessary.

The electric generator for driving the screw is totally eliminated; the compressed air being led from the bottles to the reversing type of rotary air engine.

The compressed air after performing its work of propelling the submarine, is exhausted from the engine direct into the body of the vessel, where it adds its supply of pure air necessary to sustain the life of the crew while the submarine is travelling submerged.

Hence, the longer the submarine travels submerged, the more fresh air is supplied to the crew by the vessel's engines for breathing purposes.

The rotary air engine is connected direct to the screw propeller. The oil engine is geared to propeller shaft by the Tygard variable diameter wheel drive giving variable speed and cut-out without clutch.

When air pressure becomes oppressive the oil engine is started, burning up the excess air pressure and exhausting overboard.

Air engine can be used for reversing and manouvering, and starting oil engine.

Double power may be obtained for emergencies by using compressed air in the rotary engine.

Electricity for lighting and heating can be obtained from

electric generator direct connected to small auxiliary rotary air engine.

Increased Efficiency

Reduction in engine weight rendered possible by the new type of Tygard double-acting oil engine and the substitution of the Tygard rotary engine for the electric dynamo, and its attendant batteries, will more than double the amount of mileage possible from a given weight or size of vessel, thus immensely increasing its efficiency.

This new plan will allow the submarine to accompany the fleet to any destination as part of same and permit the flotilla to operate with the same freedom of the fleet, without the limitations under the present system of a "base" of operations.

All existing submarines can easily be changed over to the new system without any extensive alterations of the boat's structure.

Life and Death

The fact that this system permits the storage of at least one hundred times more air under compression for the use of the crew renders less possible the regrettable and fatal disasters which have so often overtaken submarine boats that fail to come to the surface when they wish.

PERSONALS

W. H. Stevenson, B.A.Sc., '01, is secretary of the Power Plant Specialty Co., Monadnock Block, Chicago.

C. P. Sills, B.A.Sc., '11, is now at Seaforth, Ont.

E. H. Scott, B.A.Sc., '15, is guiding tourists throughout northern Ontario for the summer.

R. G. Scott, B.A.Sc., '15, is on geological survey work around Revelstoke.

J. B. Stitt, B.A.Sc., '15, is with the Braden Copper Co., Rancagua, Chile, South America.

J. E. C. Stroud, B.A.Sc., '15, is assistant chemist on smelter at Anyox, B.C.

O. T. G. Williamson, B.A.Sc., '09, resides at 1345 North Shore Ave., Chicago, Ill.

F. H. Wrong, '11, resides at 355 Bedford St., Sandwich, Ont.

J. A. Whelihan, '03, is ranching somewhere in the west. Try Box 165, Regina, Sask.

H. A. Wood, B.A.Sc., '15, is in charge of surveys for the Eastern Division of Toronto Harbor.

H. H. Brown, B.A.Sc., '14, in June last met with a very serious accident at the Lackawanna Steel Co.'s plant at Lackawanna, N.Y., in which his leg was broken and his hips broken and dislocated. He will be unable to engage in his profession for about another six months.

W. M. Brodie, B.A.Sc., '95, is with the Sterling Coal Company, Ltd., 95 Bay St., Toronto.

R. H. H. Blackwell, '10, B.A.Sc., '15, is with the Canadian Inspection Co., Toronto. His address is 32 Wilton Crescent, Toronto.

W. J. Blair, B.A.Sc., '02, is living in Calgary with large farming interests in Alberta.

E. W. Berry, D.L.S., '10, is on D.L.S. work. His home is at Seaforth, Ont.

L. R. Brown, B.A.Sc., '15, his address is 229 Albert St., Sault Ste. Marie, Ont.

W. H. Bonus, B.A.Sc., '15, is with the Canadian Inspection Co., address care of Empire Mfg. Co., London.

VALUE OF ECONOMICS AND BUSINESS TRAINING TO THE ENGINEER

By Eugene W. Stern, '84, M. Am. Soc. C.E.

It has become more and more evident that the engineer is occupying a continually stronger position in the industrial and business world of to-day. Not only as one who is responsible for the design and supervision and the execution of work of a constructive nature, but also as a manufacturer, manager or partner in important organizations.

There are but few large constructing or manufacturing concerns in this country, in which somewhere near the top there is not a highly competent, technically trained man. In New York city, for instance, practically all of the engineering contractors engaged on the more important work, such as the subways, the Catskill water supply system, or the Barge Canal work, have engineer members of the firm as partners.

A generation ago this was not the case. The engineer's field was not nearly so broad. His activities were confined to railroad or municipal work almost entirely. The manufacturer hardly knew him. Andrew Carnegie was one of the first of them to make use of his services and he has most generously and frequently testified to the invaluable services rendered to him by the engineering profession. Those of his competitors who did not follow his lead in this direction were driven out of business.

I believe I am not exaggerating when I say that those corporations who do not to-day show full appreciation of the engineer's work are in a state of decline.

This widening of the field has brought with it, of course, larger responsibility and the necessity for a somewhat different and broader kind of training than what would have been sufficient in the past.

Nowadays the consulting engineer must often advise financial corporations as to many things involving a broad knowledge of economics and finance. For instance, he may have to pass upon the desirability of the construction or purchase of railroads, mines, manufacturing and power plants. He would be very much handicapped were he not to understand a great many of the things which the business man, lawyer and man of affairs concern themselves with, as he has to deal with these men and look at things from their view point. He should, therefore, have a well rounded training, his equipment comprising not only his mathematics, his mechanics, his field and shop practice, but also the training to enable him to deal with the larger affairs in which a knowledge of economics and of course some business training is essential.

The engineer, contractor, or manager, must not only be thoroughly capable in methods of construction and the details of economically handling materials, but must also understand how to handle labor and be thoroughly familiar with business and financial principles and methods.

The things which I have outlined above as being to-day in the proper sphere of the engineer's work, require a broad foundation which must be acquired sometime in his career, if he is to meet his responsibilities.

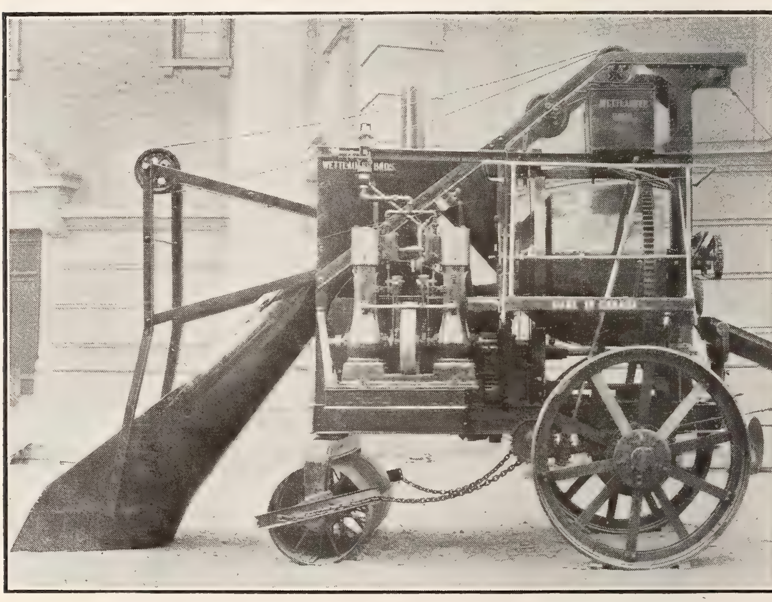
Economics, I believe, should be taught at college, as it is more or less an abstract study and its principles are readily elucidated in the lecture room.

The essential business training, however, should be acquired as an employee in the actual work, for the reason that it is much easier and quicker to obtain the right kind of business knowledge and the practical experience which goes with it, in this way.

COMBINED MIXER AND ROAD ROLLER

Every contractor has hitherto found it necessary to own at least two big machines—a concrete mixer and a road roller—in order to build concrete roads or roads with a concrete foundation. Wettlaufer Bros., Toronto, now claim that a contractor need invest in but one machine, which will take the place, they say, of both mixer and roller.

They have just placed on the market almost ingenious and unique machine—a combined concrete mixer and steam-driven



road roller. The machine weighs 24,000 pounds with roller wheels; 15,000 pounds with small wheels. The entire machine is controlled by one man from one platform, all levers being within reach. He

is not required to leave the operating platform excepting to stoke the fire occasionally.

The machine is capable of rolling at a speed of 9,284 feet per hour. The power is developed from a dry back horizontal boiler of 16-18 h.p. (at 125 pounds steam), by means of a pair of 5 x 5 twin engines, with a speed of 300 r.p.m. The machine has two speeds forward, and is reversible at each speed. The power is transmitted through cast steel gears. The power transmission is sturdily built, and this, in fact, can be said of the whole machine.

The rear roller wheels are each 60 in. diameter by 17 in. face. The front roller is 34 in. diameter by 5 ft. 9½ in. face, and is constructed as four separate wheels. Smaller wheels are also supplied with the machine to be used as desired. The over-all height of the machine is about 10 ft.; height, 12 ft. 6 in., with roller wheels; rolling width approximately 9 ft.

Forming a compact and integral part of the roller, there is mounted a heart-shaped concrete mixer, which has a capacity of 14 to 16 cu. ft. per batch, with a drum speed of 16 r.p.m. The drum is 48 in. diam. x 44 in. in length. The hopper speed is from 8 to 15 seconds. There is a boom delivery of any length desired, but the drum is built high enough to permit a gravity chute to be used to any part of the roadway. The centre of the discharge end of the drum is 6 ft. 9 in. above the ground.

The machine is not being marketed as an asphalt roller, but is primarily intended to enable the contractor to roll the subgrade at night and then to mix concrete during the day, all with the same machine. Whether or not the idea of combining a mixer with a roller proves to be practical and economical, the machine is certainly a new idea and interesting, and it will find a place in paving history.

BUFFALO EXTENSION AND RECLAMATION

By T. Kennard Thomson, D.Sc., S.P.S., '86, M. Am. Soc. C.E.

The very name of the city is a misnomer, as there is no record of bisons ever being at this site, unless, possibly, an odd one or so in captivity.

As the ultimate destiny will be a single city from Lake Erie to the Lewiston Escarpment and then, probably, on to Lake Ontario, the question of the future name of the city will have to be settled. And many wonder whether the people of Buffalo or Niagara Falls will insist upon keeping their own name.

Many prominent Buffalonians have told me that there is no justification for the name Buffalo and that, therefore, the future combined city of Buffalo, Tonawanda, La Salle, Niagara Falls and all the other intermediate towns will be, perforce, Niagara Falls.

Like all other American cities, Buffalo has made great strides, partly due to General Greene and his associates, who introduced asphalt streets so extensively into the city many years ago.

The result now is almost a solid city from Niagara Falls to Lake Erie, but under many names and governments.

It might be stated here that one of the first important highways to be built in this country was the Military Road, of about eight

miles in length, in almost a straight line from the Lewiston Escarpment to La Salle, on the Niagara River above the Falls. This diagonal short cut saved the roundabout trip by the banks of the

River and the Falls, and was built, of course, to shorten the haul of merchandise from Lake Ontario to Lake Erie—the boats being unloaded at Lewiston and the material reloaded on other boats at La Salle. Even boats were taken up in sections, put together and launched at La Salle. All kinds of furs, etc., were brought back over the same route.

After having enjoyed a period of growth and prosperity Buffalo is suffering from the lack of new enterprise, as no prosperity will continue of its own accord, and unless new ideas and new energy are put forward and pushed to completion, stagnation ensues.

Buffalonians all know that they have reached a period of serious depression, but they have not yet realized how to overcome it—and yet the remedy is perfectly obvious and ridiculously simple, when once realized, as I have pointed out to some of the members of the Chamber of Commerce and others.

Incidentally, I might remark, that in December, 1902, I submitted a plan to Mr. Rust, then city engineer of Toronto, and to others, for the improvement of the Toronto harbor—a plan which was considered at that time entirely too visionary and expensive, but which is now being carried out by the Harbor Board, and promises to make Toronto one of the leading and most up-to-date harbors on the lakes.

The plan which I have submitted to Buffalo and by which I expect to make Buffalo the greatest city on Lake Erie, consists of making a new and safe harbor on an extensive scale—which will not only pay for itself but will also supply money for other developments.

Briefly my project is:—

1st. To construct a breakwater or retaining wall from, at, or near Porter avenue, for a length of about two miles, or out to the present Government breakwater, and then continuing it for one mile beyond—a total curved length of about three miles. See plan.

2nd. To construct another retaining wall or breakwater from near the "Terrace" out to the present Government breakwater.

3rd. To construct two parallel (half a mile apart) breakwater or sea walls, from the Government breakwater, for a distance of one mile, into the lake.

4th. Cut a channel through the existing breakwater between these two parallel retaining walls.

5th. Fill in or reclaim the areas bounded by these breakwaters. See shaded portion on the plan.

These areas as shown cover about seven square miles and can be added to, to an unlimited extent, as required.

6th. Make a new Buffalo River from 500 to 1,000 feet wide, thus reclaiming and making valuable much land that is now spoiled by the winding, shallow river, railroads, etc.

7th. Build a real union passenger station, which will also have access to the lake, where the passengers from lake steamers can step directly into the trains.

8th. Construct a union freight terminal, where all the railroads

can transfer merchandise to and from each other, and to and from the lake and canal boats.

The railroad tracks should pass under the city of Buffalo by means of tunnels or subways, releasing enough real estate—now owned by the railroads—to far more than pay them for the expense of the great improvement.

9th. Utilize the balance of the reclaimed land for summer resorts and cottages on the lake front, and for manufacturing concerns behind.

The walls around the union passenger station should form an enclosed space and be carried down to bed rock, which would be found to be from twelve to twenty feet from the surface of the water. The enclosed space will then be pumped out and be ready for the foundations for the buildings, tracks, etc.

By building jetties, etc., much of the remaining portion would, in time, be filled up by the sand which comes down the lake, especially during storms, when the wind is in the right direction.

As soon as this work starts there will be railroad tunnels from the Canadian side of the river to this new land.

Another advantage will be a real terminal for the Barge Canal, for transfer to the railroads or lake boats, which will be perfectly safe and of ample dimensions.

Some people fear that the addition of new land will lower the values of the old, which is absurd. In the first place, the new land will only be added as required or paid for—in fact, after obtaining the rights to go ahead, and laying the work out on paper, enough land can be sold to start the work, and to keep the work going on; so this is not a serious engineering nor even financial problem, but simply one of education.

Cleveland and other ports will soon leave Buffalo behind if Buffalo does not soon wake up.

The fine boulevards from the parks, with which Buffalo is so well equipped, should be continued so as to pass by the proposed union passenger station, and on through the new land, using tunnels under the channel.

The new city, or rather extension of the City of Buffalo (or Greater City of Niagara Falls), which will be created by this undertaking, **should have all the space—for a depth of one floor—below the street level, kept free, so that it will never be necessary to tear up the street surface to lay pipes, sewers, subways, etc.,—in short a model city should be laid out from the start.**

The lake shore on the new land should be kept for cottages on one side of the boulevard, and bathing beaches on the other side; and this can be gradually pushed out into the lake as the manufacturers require more room. In addition to manufacturing concerns of all kinds, which will be accommodated here, ample room will be provided for coaling stations, lumber yards, grain elevators, dry docks, ship building yards, automobile works, submarines, aeroplanes, etc.

With unlimited cheap electric power, good money and labor markets at hand, and this work started—can anyone imagine stagnation in Buffalo for many decades to come?

LETTERS FROM GRADUATES

Can a Duck Swim?

Dear Mr. Editor,—On page 51 of your June-July issue, "A Graduate" asks if there is a "School" spirit after graduation? In reply I ask another question which it seems to me is just as serious: Can a duck swim? Anyway, the answer to both questions is the same.

The measure of the strength of the "School" spirit is another matter. My experience of twenty-odd years since graduation has taught me that the "School" spirit is stronger than the tie that exists amongst graduates of many other universities. I submit, however, that it is not so strong as it ought to be.

In case "A Graduate" has not met this spirit since he left, I would say that it manifests itself by arousing interest when one School man meets another, by pleasant reminiscences of the four School years, by a desire to join with other School men on occasions, by an interest in the perusal of APPLIED SCIENCE, by a desire to know what is happening in School affairs, by the satisfaction of reading of School successes, by the pride that arises when another School man comes to the top, and by the thrill set up at the sound of the joyous Toike Oike! Toike Oike!

Should there be a "School" spirit after graduation? Undoubtedly there should.

And in reply to the last question, "Of what use is it?" One is tempted to throw up his hands and reply "What's the Use?" In my opinion the usefulness of the School spirit is beyond estimation. I have already suggested usefulness in discussing the manifestations. Let me go on. If the school spirit were properly cultivated, every graduate would subscribe for APPLIED SCIENCE and pay for it, thus making our College paper financially independent, instead of face to face with indebtedness. (School men don't appreciate APPLIED SCIENCE enough, not realizing that it is a most creditable periodical. I am proud of having a complete set from 1885 to date). If the proper School spirit existed there would be a closer bond of union between the faculty and the graduates than that which now exists. If there were true School spirit more of the School men would have better positions than they hold, even if no other principle applied than that of giving a fellow-graduate the preference, other things being equal. And I cannot help feeling that a really true School spirit would lead more of our graduates to take an interest in the great professional societies, for by so doing they would help to elevate themselves, assist in raising the standard of the profession and at the same time place the School in the high place that it deserves.

"A Graduate" who is glad to sign himself,

WALTER J. FRANCIS.

INCREASED PRODUCTION IN CANADA

By Wm. Batten McPherson, B.A.Sc., '11

Many Canadian manufacturers have suffered greatly from the effects of the war. There has been a great dropping off in agricultural implements, steel rails and most other steel products except wire and in various materials used in building and construction. War conditions explain the increases that have accumulated and wheat and foodstuffs as much as cartridges and shells largely explain the situation. France and England are taking enormous quantities of wheat and will continue to do so.

Canada has sent little ammunition to Europe as yet but by October and November Canadian munitions will commence to play a part in deciding the issue, for according to the experts, not the soldiers in the trenches but workmen in the factories, are now carrying on the war. The Allies have a stupendous task clearing the Germans out of Belgium, France, and parts of Russia. The war will probably not be decided until this is done. Military men scout the suggestion that this is an impossible task. Modern engineering can blast its way through mountains of rock; similarly it can blast its way through human impediments in Belgium and France. And in all its hideousness, that is the aspect this twentieth century military situation presents.

No forces, even that of human beings, can withstand the shock of lyddite and melinite. It is only a question of hurling enough at the obstruction. Shrapnel shells exploding in a fan-like mass of bullets over the trenches, produce little more permanent effect than the sprinkling of toilet water; they kill men indeed but the great defences, the trenches are still there, and there are apparently new victims enough to fill the vacant places. But huge charges of high explosives, falling in or near the trenches, simply tear them to bits; concrete, earth and fragments of human beings mingle together in one horrible destruction.

If the Allies can do on an enormous scale, what the English did at Neuve Chapelle and the French at Souchez, they can literally blow the Germans across the Rhine. If the Germans can utilize the same methods against the Allies they can win the war. The issue depends upon which side can use lyddite to the greatest effect. This in turn, hangs upon which side can get the largest quantities.

The countries that send to their armies at the front the largest quantities of explosive shells will probably win this war.

Germany and Austria depend only on themselves. The Allies depend on the remainder of the world. Canada must take her place. The enemy has prepared large quantities of munitions in anticipation of this war, they have been exploding it at a prodigal rate in the past year. When they have exhausted these supplies what are their facilities for further manufacture? How extensive is their access to raw materials? By occupying Belgium, Northern France and Luxembourg, they have acquired territories rich in metal mines which will strengthen their resources. But the position of the

Allies is stronger. England and France can lay the whole world under tribute. Both countries had small reserves of munitions when the war began. But so long as they can hold their present position, they can beat time until they have organized a great and steady supply. They can draw raw materials from a dozen sources in other countries. Canada must be included. We require to work our factories as well as recruiting stations. With England, France, Russia and Italy enlisting the world's mining and manufacturing resources and Germany and Austria depending on themselves, the great military superiority of the Allies becomes apparent. Every man in the field requires at least one man in the workshop. Germany and Austria have to keep millions of their finest men in the factories—men who would otherwise go to the front. But the Allies can enlist huge armies of workmen, the world over—men who are really fighting their battles as immediately as though they were stationed in the trenches.

The newspapers describing great war orders received by American manufacturers, and the extensions which these same concerns are making to their plants give some idea of this new industry. We believed that the production of ammunition was a specialized industry; that only factories constructed for that purpose could do it. But practically any factory that has a lathe can turn out shells. A list of sub contracts let by the Canadian Car and Foundry Company in the United States illustrates this point. Manufacturers of hardware, automobiles, recording and computing machines, drop forgings, locomotives, farm implements, bicycles, screws, steel cars and a dozen other products are now turning their energies to producing shells. Canadian industries are receiving orders but more of our manufacturers can adapt their plants to obtain their share of business and to do their part. Concerns that have been making shrapnel can make explosive shells also; indeed these are less complicated and easier to make than shrapnel, and when our factories can add hundreds of these shells a week to the output of the Allies the situation on the battlefields will gradually change.

Amongst the effects of the war on Canada are the improved understanding and the friendlier feeling between the industrial east and the agricultural west. The common interest involved in increased production has brought the grain grower of the prairie provinces into a harmonious relation with the manufacturer of the east. It is freely recognized that the present world struggle is one of resources and that the supreme duty of Canadian citizens at this time lies in the utilization to the utmost of the bountiful resources with which we have been blessed.

A substantial increase in Canadian production on a sound economic basis is an essential step at the present stage of this country's development. A campaign has been launched to encourage and stimulate larger production in all parts of Canada. The importance of raising larger quantities of meat supplies has been particularly emphasized. The live stock industry has not kept pace with agriculture and manufacturing. During the past twelve years wheat

production in Canada has more than trebled. Manufactures have been doubled in volume of output. Horses have increased fifty per cent., but food animals have increased in that time less than twenty per cent. Now that the prices of all kinds of grains and fodder have advanced to record heights, the problem of making a profitable business out of cattle, sheep and swine is a difficult one to solve.

Increased production from the land is the basic argument in the campaign which has arisen as the result of the war. All other increased outputs in Canada must depend upon that which comes from the soil. Of late years the volume of business in Canada has not been proportional to the size and value of the yield of produce from the soil. The future was taken into account to an exaggerated degree, and in Western Canada particularly, banking, railway construction, municipal and all manner of civil works advanced until they were ten years ahead of their time. The land is now sought as the best economic means of squaring the nation's foundations and fighting the Empire's battles. This year the grain crop of Canada promises to be exceedingly large and it is a national undertaking to see that every farm is manned with an adequate supply of labor. It would seem necessary that many of the unemployed industrial workers in the towns and cities must serve their apprenticeship as farm laborers.

It has been said that the present crisis has brought into relief several very important facts. First, the transcontinental railway systems necessary for a considerable margin of further agricultural development are practically completed. Secondly the country is provided with industrial machinery for a population considerably in excess of its present numbers. Thirdly, the development of the primary industries of the country has been relatively inadequate. Fourthly, the financial situation is well in hand and presents no insoluble difficulties. In the first two cases there has been probably both waste and over anticipation of increase of population, but at all events, the work is done, the money has been borrowed, the responsibility is shouldered, and, as a matter of fact, the country as a whole is amply able to carry the burden. In any case we find ourselves in possession of some 36,000 miles of railway in reasonably good condition, and more than adequate to deal with the large task involved in conveying to market the primary products of a country situated as Canada is, with a small seaboard and a long, relatively narrow tract of country.

In regard to the internal economic condition of Canada, it is perfectly natural that the newer parts of the country should be the main centres of anxiety. Several cities in the west have been somewhat embarrassed by extravagant assessment of city values, and too much haste to proceed with municipal improvements ahead of actual requirements.

They have lost and are losing population, and the collection of taxes on their high assessment values has been somewhat difficult, but on the whole these towns appear to be meeting the situation with courage, show no disposition to consider the question of default

on their interest and in many cases are beginning the process of cutting down their assessments. Although last year prices for grain stuffs were high, it must be remembered that the crop was small. Still the principal and interest on farm mortgages were surprisingly well met. The effect of this year's large crop on the whole west must be very beneficial indeed, and it is quite inevitable that the western cities will get their share of the benefits accruing.

The trade returns of the Dominion for the last fiscal year reflect the general trade restriction both before and during the war up to March 31st last. As compared with the preceding year there was a net decrease of about 158 millions in the exports and imports of merchandise.

It is encouraging to note that for the first time in many years the balance of trade for the year in regard to imports and exports of merchandise is in Canada's favor, the total imports being $455,-471,471 while exports are valued at $461,442,509. The imports of coin and bullion during the last fiscal year amounted to no less than $131,992,992 as compared with $15,236,305 for the preceding year. Canada's imports from the British Empire for the year totalled $116,272,787, a decrease of nearly $40,000,000 as compared with the preceding year. Imports from Great Britain which totalled $90,085,840 fell off by nearly $42,000,000. Imports from the British West Indies, however, increased by nearly $2,000,000. Imports of merchandise from the United States last year totalled $296,632,506, a decrease of nearly $100,000,000.

Canada's exports to British Countries during the year totalled $237,558,704, a decrease of nearly $10,000,000 nearly all of which was in exports to the United Kingdom. As compared with this Canada increased her sales of Canadian produce to the United States some $10,000,000 the total for the year being $173,320,798. During the year Canada bought from the United States $123,000,000 worth of goods more than she sold to the United States. In the case of Great Britain the Dominion sold $121,000,000 worth of goods more than she bought.

The increase in exports of merchandise during the year was due solely to the increased transportation through Canada of foreign produce, which was greater by some $28,000,000 than in the previous year and was made up principally of horses, oats and wheat bought from the United States for war purposes and shipped through Canadian ports.

The exports of Canadian produce show a decrease of $22,169,603. Exports from the mine decreased from $52,039,054 in 1914 to $51,-740,989 for 1915; the fisheries from $20,623,560 to $19,687,068, agricultural products from $198,220,029 to $134,746,050.

On the other hand exports of animal produce increased from $53,349,119 to $74,390,743 and of manufactures from $57,443,452 to $85,539,501. The increase in the exports of animal produce reflects, of course, the large sales to the United States of beef cattle following the taking down by the United States of the tariff barriers.

The increase in the exports of manufactures is largely due to Canadian sales of war munitions to the Allies.

The effects of the war are seen in the figures of the trade with France and Germany. Imports from France last year totalled $8,449,186 as compared with $14,276,378. Exports to France totalled $14,595,705 as compared with $3,810,562 for the preceding fiscal year. From Germany Canada bought during the twelve months goods to the value of $4,314,805 as compared with $14,586,223 for the preceding year. To Germany Canada sold last year goods to the value of $2,162,010 as compared with $4,423,736 in 1913-14. The total trade of Canada with Germany in 1913-14 amounted to $19,019,969. In 1914-15 it amounted to $7,248,996. This year it will be nil. The "Balance of Trade" which is in this country's favor by about $6,000,000 will be largely increased during the present fiscal year.

The following table published by the London *Daily News* and leaded, is interesting and directs attention to the population and resources of the belligerents as follows:—

Nation	*Population*	*Resources*
British Empire	439,000,000	$2,245,000,000
Russia	174,000,000	1,700,000,000
France (with colonies)	80,000,000	1,100,000,000
Italy	38,000,000	565,000,000
Japan	53,000,000	325,000,000
Belgium (including the Congo)	7,500,000	(unstated)
Servia	3,000,000	42,500,000
Montenegro	500,000	2,500,000
Total	795,000,000	$5,980,000,000

Against these forces are aligned:

Nation	*Population*	*Resources*
Germany	65,000,000	875,000,000
Austria	29,000,000	700,000,000
Hungary	21,000,000	470,000,000
Turkey	21,000,000	85,000,000
Total	136,000,000	$2,130,000,000

This table is interesting and the figures given sum up one result and that is final overwhelming triumph of the Allies.

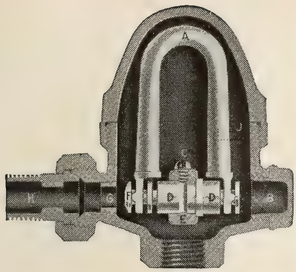
F. M. Buchanan, B.A.Sc., '15, has recently received the appointment as foreman on the Wayne County Concrete Roads, Michigan.

T. R. Banbury, B.A.Sc., '15, is with the Canadian Inspection Co., at the Empire Mfg. Co. Ltd., London.

W. M. Currie, '04, is vice-president and general manager of the Burlington Steel Company, Hamilton, Ont.

J. Chalmers, '94, is a consulting engineer. His address is 13012 104th Ave., Edmonton, Alta.

A NEW RADIATOR TRAP



The thermostatic member used in this valve consists of a specially designed spring-tempered steel tube, heavily copper plated and contains a volatile fluid, hermetically sealed, which is so sensitive that a change of one degree is sufficient to start the valve in operation. This tube is held in a central position by a guide, cast solid with the body of the valve. A cap nut is provided on the side of the valve directly opposite the seat through which the valve mechanism may be inserted, or for testing the operation of the valve while it is in service.

The entire valve mechanism is mounted on a sleeve which acts as a guide for the valve head, and also supports and holds the thermostatic member so that the movement due to expansion and contraction must open and close the valve. This sleeve is supported and held in position by a bridge which is cast solid with the valve body. The valve head is of bronze and is so arranged that any movement of the expansion member will cause the valve head to move forward or back. The valve seat is a tempered bronze seat inserted into the body of the valve.

When steam is turned on, the thermostatic tube is neutral, under which conditions the valve is wide open, giving the full valve area. The valve remains in this position until all the air and condensation have been removed from the radiator (or point to be drained), but just the instant steam arrives, the tube expands, closing the valve absolutely tight. As condensation forms, the temperature lowers and the tube contracts, moving the valve from its seat, thereby permitting the condensation to be discharged.

Owing to the re-evaporation of the condensation when passing from a slight pressure to vacuum, the vapors from the hot water are sufficient to actuate the tube, thus preventing any measurable amount of vapor from passing through the valve. Attention is directed to the exceptionally large valve-opening. Any scale, sand or other foreign matter which may enter the valve drops to the bottom, and the valve seat being at the side and in a vertical position is thus kept clean and free from any foreign obstruction.

This valve is absolutely noiseless in operation, its construction makes it impossible for the valve head to flutter, and due to the fact that the valve seat is in a vertical position, foreign matter will not lodge on it and cause a hum due to the steam wire drawing.

These traps are manufactured by Wm. S. Haines & Co., Philadelphia.

THE ENGINEERS

The ways of the Lord be manifold, He has fashioned divers men
To fret the Earth for a little space with labour, laughter and tears,
To strut in the light till the world forgets and buries them deep—and then
The Lord He stiffened His good right arm and fashioned the Engineers.

Where the naked ribs of the liner curve, and the straining rivets whine,
Where the plunging crosshead spatters the oil in the incandescent's glare,
Where the clanging coal scoop swings in the gloom, and the blistering clinkers shine,
Behold him—cool as an iceberg's foot—the Slave and the Master there.

When you come to the end of the old known land, to the far horizon's rim,
To the raw crude plain where the uplands lift and the mountains clamber sheer,
The small wise men of the ledger halt, and the call goes forth for him
Who laughs at the everlasting hills—the Master, the Engineer.

By lathe and chisel, by hammer and forge he is shaping the things that be,
He has harnessed the stream to his dynamo, he has said to the tides, "Beware."
He grubs in the echoing womb of the earth, and sits on the floor of the sea,
And rides athwart of the thunderstorm in the hollow caves of air.

Smooth and silent and very sure, he fingers the locking switch,
Where the yellow copper is glutted with death as it gleams on the marble wall,
And he turns on his heel when the red lamps wink, to balance his power and pitch
Through the gloom of the throbbing canyon streets the might of a water fall.

He weighs the world and the eye of a fly and he measures the light of a star,
And plays with a key at the end of a wire till the slumbering cities hear.
He whispers low and cradles his words on the curve of a waxen jar
That the bottom end of the earth may list to the voice of the Engineer.

He has come to grips with eternal truth, and he dallies not with lies;
He has ravished his mind of its small conceits and he knows not how to shirk,

For the Thing—the ultimate perfect Thing, is glimmering in his eyes
And a voice, a small reiterant voice, is whispering—"Will it work?"

When we come in time to the end of the road, to the step of the Golden Gate,
We shall see a fellow in overalls, and he'll probably stop and peer
To see how the gate is built, and then, if we only watch and wait
We shall notice him oiling the golden hinge—the beggar—the Engineer.

ALAN SULLIVAN, S.P.S., '89, in Popular Magazine.

PERSONALS

W. G. Collinson, B.A.Sc., '09. His address is 532 4th St., Niagara Falls, N.Y.

R. J. Campbell, '95. His present address is 1218 Corn Exchange Bldg., Chicago.

A. J. Campbell, B.A.Sc., '04, resides at Collingwood, Ont.

H. R. Carscallen, B.A.Sc., '08, is assistant hydrographer in Irrigation Branch of Department of Interior at Calgary.

A. Cameron, '06. His present address is care of Provincial Architect's office, Winnipeg.

A. B. Crealock, B.A.Sc., '15, is draughting for the Toronto Rapid Transit. His address is 61 Geoffrey St., Toronto.

Geo. F. Dalton, B.A.Sc., '14, is on Geodetic Survey work with the Department of Interior. His address is 342 McLaren St., Ottawa.

W. L. Dickson, B.A.Sc., '15, is with the Canadian Inspection Co., at the Empire Mfg. Co., Ltd., London, Ont.

E. R. Frost, B.A.Sc., '09, resides at 159 Wentworth St. N., Hamilton.

H. P. Frid, '11, is a member of the firm James Frid & Co. Ltd., consulting engineers, Hamilton. His address is 607 Bank of Hamilton Bldg., Hamltion.

H. J. Franklin, B.A.Sc., '14. His permanent address is 72 Delaware Ave., Toronto.

J. S. Galletly, B.A.Sc., '07, resides at Osahwa, Ont.

R. S. Houston, '06, his present address is care of Dominion Bridge Co., Ltd., Winnipeg.

L. J. Hayes, '03, now resides at 2434 Niagara Ave., Niagara Falls, N.Y.

R. A. Henry, B.A.Sc., '13, is with the Maritime Bridge Co. of New Glasgow. His address is Box 1017, New Glasgow, Nova Scotia.

J. E. Hanlon, B.A.Sc., '15, is a surveyor for the Hollinger Mine at Timmins, Ont.

Dion S. Halford, B.A.Sc., '15, is with the Consolidated Arizona Smelting Co., Humboldt, Ariz.

E. W. M. James, B.A.Sc., '09, now resides at 445 Rosedale Ave., Winnipeg, Man.

K. A. Jefferson, B.A.Sc., '15, is with the Canadian Inspection Co. at the Empire Mfg. Co. Ltd., London.

J. A. Knight, B.A.Sc., '14, formerly with the Foundation Co. of Montreal, has enlisted with the Third Cyclist Corps.

E. J. Laschingle, B.A.Sc., M.E., '92, is hydraulic and air power engineer with the Central Mining & Investment Corporation Ltd. His address is Box 4563, Johannesburg, S. Africa.

R. W. E. Loucks, '09, is inspector of surveys, Land Titles Office, Surveys Branch, Regina, Sask.

R. E. Lindsay, B.A.Sc., '14, residence, 282 Ossington Ave,. Toronto.

J. T. Mogan, B.A.Sc., '15, is on the Toronto Harbour Commission work.

J. M. Muir, B.A.Sc., '15, is with the Department of Education, Toronto.

J. A. MacMurchy, '96, address is 1315 Elm Street, Wilkinsburg, Pa.

C.O.T.C. MEN WHO PASSED THE OFFICERS' EXAMINATIONS

Out of seven hundred University men who wrote on the examinations of the Canadian Officers' Training Corps, only 153 passed. This was due to the examinations being much more severe than formerly, and not because of the rumored differences between the C.O.T.C. and military authorities. The following is the list of successful candidates:—

L. S. Aldard, D. R. Agnew, J. W. Ansley, R. H. Barbour, V. A. Beacock, S. Beatty, E. G. Berry, C. H. Black, A. S. Bourinot, W. F. Bowles, H. S. Brewster, J. C. W. Broom, L. A. Broughton, H. D. Brown, P. B. Brown, R. A. Brown, G. F. Bryant, J. T. Burns, T. D. Campbell, J. R. Cockburn, G. M. Dallyn, W. A. Dean, S. H. Dixon, G. P. Dunstan, C. Feeney, C. B. Fisher, E. M. Fraser, R. A. Fraser, F. H. Galpin, J. A. Garvie, J. A. Gilchrist, R. V. Gordon, D. S. Graham, H. H. Graham, H. C. Green, E. W. Haldenby, C. W. Harris, R. M. Harvey, W. J. Hearst, J. E. Hill, F. W. Hepwell, A. M. Horner, E. Howell, A. H. Isbister, T. H. Jamieson, A. M. Jeffrey, F. M. Johnston, G. W. F. Johnston, F. B. Kenrick, G. W. Kaiser, J. A. Kingsmill, W. W. Lang, G. W. Lawrence, H. O. Leach, H. B. Little, M. I. Machell, D. Maclean, J. P. Magwood, J. A. R. Mason, A. W. McConnell, W. R. McGie, H. C. McKendrick, A. P. McKenzie, D. S. McPherson, J. H. Moxley, J. M. Muir, J. G. Murray, F. S. Parney, G. Pilkey, J. R. Pounder, J. D. Relyea, W. W. Ritchie, C. C. Robinson, B. J. Roberts, H. M. Rowe, R. A. Seymour, J. E. Sharman, W. L. Sagar, M. R. Shier, K. G. Sinclair, W. E. Smith, W. J. Southcombe, W. A. Steele, E. C. Tate, W. D. Thomas, H. R. Thomson, W. M. Treadgold, H. D. Wallace, A. L. Ward, H. S. Weldon, R. H. Williams, W. J. T. Wright, H. H. Wrong, L. E. Willmott, L. L. Youell, J. R. Robinson, W. Hegers, J. M. Aylward, W. H. Bonus, B. D. Carlyle, J. M. Cunningham, H. A. Elliott, J. A. Harston, J. R. Manning, L. M. Murray, R. B. Pichard, G. A. Snow, J. S. Wear, K. A. Jefferson, W. H. R. Gould, G. K. William, R. L. Killock, G. Rosser, A. L. Huether, G. W. Brown, T. M. Kerruish, E. Machell, H. C. Budd, W. A. Smelser, W. L. Dobbin, C. R. McCort, A. Chambers, F. L. Mitchell, C. R. Albright, W. T. Miller, J. S. Beatty, A. M. Boyd, F. C. Carter, R. S. Cassels, W. W. Davidson, M. L. Ellis, A. M. Garden, J. N. Garrow, E. L. Greene, R. W. Hart, J. S. Hodgson, R. A. Laidlaw, H. E. Manning, K. F. McKenzie, N. M. McLeod, W. B. McPherson, W. W. Parry, C. F. Ritchie, H. D. Scully, A. C. Snively, C. L. Wilson, E. V. Graham, C. B. Scott, H. P. Stewart, R. P. McCormack, R. B. Whitehead, D. W. Lang, D. B. Gillies.

DAVISON-HASTINGS

At Pittsburgh, Pa., in September, 1914, H. D. Davison, B.A.Sc., '13, of Bridgewater, Nova Scotia, was united in marriage to Miss Helen Hastings of Pittsburgh, Pa.

HAYES-O'BRIEN

At Albany, New York, on May 29, 1915, L. Joseph Hayes, '03, of Toronto, was united in marriage to Loretta M. O'Brien, of Albany, N.Y. Mr. and Mrs. Hayes will reside at Niagara Falls, N.Y.

DAVISON-MARSHALL

In January last at Bridgewater, Nova Scotia, Mr. R. F. Davison, '13, was united in marriage to Miss M. Marshall, of Annapolis, Nova Scotia.

SARA-HANNA

Mr. and Mrs. A. E. Hanna, 1123 Grosvenor Ave., Winnipeg, announce the engagement of their only daughter, Evelyn B., to Mr. Richard A. Sara, B.A.Sc., E.E., '09, youngest son of Mr. and Mrs. J. H. Sara, Toronto. The marriage will take place on September 29th.

SHEARER-PUGSLEY

Rev. Will and Mrs. Pugsley, Yorkville Ave., announce the engagement of their daughter, Bessie May, to Mr. Harry Foster Shearer, B.A.Sc., '08, Toronto, son of Mr. and Mrs. Charles E. Shearer, Vittoria, Ont. The marriage will take place early in September.

PENNINGTON-CHIPMAN

Mr. and Mrs. Willis Chipman announce the engagement of their daughter, Gertrude Elma, to Charles Wakley Pennington, B.A.Sc., '14, of Dundas. The marriage will take place quietly early in September.

C. P. McGibbon, '04, resides at 124 James St., Hamilton.

V. McMillan, B.A.Sc., '09, is with the Canadian Inspection Co. at the Empire Mfg. Co., London.

O. B. McCuaig, B.A.Sc., '04, C.Q.M.S. No. 5302, No. 2 Field Co. Divisional Engineers, First Contingent, Army P.O., London, Eng.

H. C. McMordie, B.A.Sc., '08, formerly with the Trussed Concrete Steel Co. at Winnipeg, has volunteered for overseas service and we believe he received a commission with a Winnipeg battalion.

O. W. Martyn, B.A.Sc., '09, is a member of the firm Martyn & MacDonald, civil engineers and surveyors. Address, Box 443, Swift Current, Sask.

A. W. R. Maisonville, B.A.Sc., '10, is with the Dominion Bridge Co., Montreal.

C. R. McCort, B.A.Sc., '15. Address, 519 Clark Ave., Westmount, Que.

EDITORIAL COMMENT

NEW SUBMARINE ENGINES

In this great war for humanity which is being waged in Europe, one thing stands out above all others: namely, that this is primarily a war waged by machines against machines. Mechanical genius is now being refined in the great crucible of immediate adaptability to present ends. The weak or fundamentally incorrect is tried and immediately wasted. The strong is improved and adapted to further uses. Above all the germ of new ideas is being sought, and it may be that in the utilization of compressed air for propelling the submarine when submerged Mr. Tygard has presented a new line for experiment. We have just the rough outline of the idea presented to us in the present article and can only hope for a fuller demonstration in the future.

There are two or three points worth considering, however. Granted the fact of noxious gases from electrical storage batteries, of what increased purity would the compresed air be after being exhausted from the rotary air engine? Again is it possible in the same time to store the same working quantity of energy in the air as could be stored in batteries. Further would not the exhaust from such an engine very materially lower the temperature of the submarine even to the point of frigidity? Another interesting point which would call for explanation is how the exhaustion overboard of the gases from the oil engine is to be accomplished given the air pressure in the submarine as excessive and the craft submerged. Would it not be as practical, if at all possible, to exhaust the air direct?

All of these questions bear vitally on the feasibility of the idea. They have, no doubt, been met by Mr. Tygard from the outset, and we await with interest a more complete description.

BOARD OF ENGINEERS

Has the engineering body of Canada realized as a whole that this war is to be to a finish and that that finish is far away? Have they appreciated the fact that before this war is over conditions in Canada must come to that of England at the present time. Everything will have to be made subservient to the war,—bridges, buildings, paving streets, municipal works of all sorts, must all eventually become of secondary importance? What can the engineers do? At least a partial answer to this is not hard to find.

England at the present time is being gone over with a fine toothed comb by the British Munition Department and its auxiliary advising boards. Factories of all kinds are being adapted to the manufac-

EDITORIAL COMMENT

ture of war supplies,—cloths, guns, ammunition, and equipment. Matters are to an extent being taken out of the owners' hands because of necessity. What is the result but that a more cheerful spirit is pervading the country and order is coming into being.

Take the United States, a country not at war, and from present indications not likely to be. Secretary of the Navy Daniels has announced the formation of a board of the most eminent creative geniuses of that country, headed by Thos. A. Edison; for what purpose? To apply their gifts to the improvement and perfecting of the arms of the United States. All this, mind you, before war is contemplated.

Now let us look at Canada. We have done wonders. From a production of munitions practically nil we have attained an output of over 25,000 shells per day. We have the best aeroplane engineers working constantly. Our woollen mills are keeping up with present demands. But what more might be done? Ammunition and guns with more ammunition is the cry from Europe and we pat ourselves on the back and point to our present output. But here is the chance for Canadian engineers to do something patriotic. At present a manufacturer, before he can obtain a contract for munitions, has to satisfy the authorities of his ability to fulfil that contract. He is put to the trouble of engaging engineering skill to rearrange his plant to meet new conditions. These alterations are made in no standard way, and as has often been the case, have had to be further revised.

Why should the engineers wait for the Canadian Government to move towards lending a hand to all those plants which might aid in the production of war supplies. Why do they not rather approach the government and show the need for concerted and thoughtful action. What is needed is a business like stocktaking of all the possible sources of manufacture in Canada. Then the best engineering brains of Canada under Governmental control and working to the Government's own specifications, should step in and take charge of the alterations for the owners and carry the work to a speedy and correct end. An engineering body of this kind working with complete information could accomplish wonders in Canada and this concentration of energy would not stop there. It would awake the country as in no other way, to the seriousness of the time. It will ultimately come, but why wait for governmental action? Canada has the engineers, and if they have a proper understanding of the word "patriotism" it is up to them to impress the government with the need for immediate scientific action, in remantelling our manufactures, etc., for the present work of the Empire.

EDITORIAL COMMENT

ATTENTION OF ALL

As a means of increasing the "get-together" spirit of "School" men, now that the Exhibition is on, let us ask each and every graduate to call at the office of the Society in the Old Red Building and make themselves known while in town. Make this office the headquarters for your stay and utilize the conveniences of the Society at this time. Our new and comfortable smoking room, in which you will find all the daily papers are at your disposal, as is also our library. Get in touch with the other fellow once more; find out what is being done by the Society; learn the problems we are trying to meet and let us profit by your experience and advice. All graduates anticipating a visit to the city at this time are requested to send their name and probable city address for our Exhibition registry and we will do what we can to get you in touch with other School men. *The office is open every day from 9 a.m. to 5 p.m. (excepting Saturday, and the telephone number is College 5000.* The West door *only* is open.

ON ACTIVE SERVICE

G. R. Johnson, B.A.Sc., '13, with the King Edward Horse, Machine Gun Division, 12th Brigade B. E. Force.

Grant Gooderham, B.A.Sc., '15, and **R. D. Delamere, B.A.Sc., '14,** have completed their flying course at Toronto and received their commission in the Imperial Service.

G. K. Williams, B.A.Sc., '10, has joined the Aviation Corps.

C. Hewson, '17, with the Aviation Corps.

Geo. G. MacLennan, '10, has enlisted for overseas service with the Aviation Corps.

J. A. Knight, B.A.Sc., '14, has enlisted with the Third Overseas Cyclist Corps, which is being recruited from the Corps of Guides.

Lieut. E. V. McKague, B.A.Sc., '15, has received a commission with the Third Overseas Cyclist Corps.

Capt. G. B. Schwartz, '16, is in command of the Third Overseas Cyclist Corps.

Lieut. R. D. Galbraith, B.A.Sc., '15, has received a commission in the 92nd Battalion with the Queen's Own.

H. C. McMordie, B.A.Sc., '08, we believe, has received a commission with a Winnipeg Battalion for overseas service.

Lieut. A. P. Linton, B.A.Sc., '06, has received a commission with the 68th Battalion C.E.F. at Regina, Sask.

Lieut. R. K. Northey, B.A.Sc., '11, is also with the 68th Battalion recruiting at Regina, Sask.

Wm. A. O'Flynn, B.A.Sc., '11, has accepted a position as 2nd chemist for the Mond Nickel Co., Coniston, Ont.

J. J. Philips, B.A.Sc., '13, is installing machinery for Abitibi Power & Paper Co., Iroquois Falls, Ontario.

J. A. Ryckman, '06, is field engineer on the Bloor St. Viaduct, Toronto. Address 300 Clendenan Ave., Toronto.

D. C. L. Raymond, B.A.Sc., '04, is with the Raymond Construction Co. of Montreal, who are doing concrete work in connection with the Rosedale section of the Bloor St. viaduct.

UNKNOWN ADDRESSES

OUR READERS WILL CONFER A FAVOR IF THEY WILL KINDLY ADVISE US OF THE CORRECT, OR MOST RECENT KNOWN ADDRESSES, OF ANY OF THE MEN LISTED BELOW

Acres, H. G., '14.
Alexander, J. H., '04.
Barrett, J. H., '03.
Bertram, G. M., '01.
Binns, R. E., '13.
Boswell, W. O., '11.
Boulton, W. J., '09.
Burgess, J. R., '10.
Bowman, A. M., '86.
Brackenreid, '11.
Brown, D. B., '88.
Brown, H., '11.
Brown, E. I., '08.
Brown, E. W., '09.
Bruce, W. J., '07.
Burnham, F. W., '04.
Cameron, M. G., '09.
Campbell, A. W., '06.
Campbell, J. E., '08.
Carey, B., '99.
Chambers, E. V., '14.
Chantrell, E., '05.
Charlebois, J. P. C., '08.
Chisholm, D. C., '10.
Christie, V., '06.
Clark, G. T., '06.
Clendenning, A. C.
Coulter, G. P., '07.
Darroch, J., '08.
DeGuerre, F. C., '11.
Derham, W. P., '09.
Dowling, F., '05.
Elliott, J. C., '99.
Evans, J. H., '11.
Evans, S. D., '07.
Evans, S. L., '08.
Flynn, C. C., '11.
Foreman, W. E., '99.
Forester, C., '93.
Francis, C. C., '08.
Gray, J. E., '09.
George, R. E., '03.
Gourley, W. A., '03.
Harris, H. C., '13.
Heebner, M. B., '11.
Horton, J. A., '03.
Holmes, H. E., '11.
Hull, H. S., '95.
Johnston, G. K., '03.
Jones, G. R., '06.
Kean, D. L., '09.
Keefer, A. H. E., '09.
Keys, W. R., '08.
Killip, W. C., '08.
King, C. F., '97.
Lawson, W. L., '92.
Lott, A. E., '87.
Macdonald, F. R., '08.
Macdougall, A. C., '01.
MacFarlane, E. D., '09.
McKay, A. G., '07.
McKay, J. T., '02.
McKenzie, D. W., '05.
MacLachlan, W. A., '09.
McLean, W. N., '05.
McLeod, G., '09.
McLeish, A. G., '11.
McPherson, J. A., '06.
Macpherson, N. W., '09.
McTaggart, A. L., '94.
Malone, J. E., '08.
Martin, F., '87.
Matheson, W. C., '01
Maus, C. A., '03.
Mennie, R. S., '02.
Milligan, G. L., '08.
Mitchell, L. C., '11.
Montague, F. F., '06.
Munro, F. V., '03.
Murray, J. D., '07.
Niebel, E. H., '11.
Nourse, A. E., '07.
O'Brien, E. D., '05.
O'Gorman, C. A., '09.
Oliver, J. P., '03.
Parke, J., '04.
Paton, T. K., '07.
Paulin, F. W., '07.
Pearce, K. K.
Pearson, C. L., '11.
Pope, A. S. H., '99.
Roaf, J. R., '00.
Sanders, W. K., '06.
Shipley, A. E., '98.
Shortt, J. H.
Smith, F. L., '10.
Squire, G. E., '11.
Stamford, W. L., '08.
Stuart, J. L. G., '07.
Szammers, C. F., '11.
Taylor, J. W. R., '08.
Thomas, V. C., '08.
Thomson, J. E., '06.
Venney, L. T., '06.
Williamson, D. A., '98.
Wilson, F. F., '09.
Wilson, W. H., '10.
Wilkes, G. H., '11.

PERSONALS

D. F. Robertson, D.L.S., '04, is surveyor in the Department of Indian Affairs, Ottawa.

H. L. Roblin, B.A.Sc., '11, is with the Canadian Inspection Co., at Galt. Address care of Y.M.C.A.

H. A. Ricker, B.A.Sc., '08. Residence, 93 Sanford Ave., S., Hamilton.

C. C. Rous, B.A.Sc., '13, resides at 59 St. Cyrille St., Quebec.

A. A. Richardson, B.A.Sc., '15, has recently accepted a position in charge of some harbour work for the Canadian Stewart Co., Toronto.

N. H. Sturdy, '05, residence, 426 Emerson Place, Youngstown, Ohio.

G. C. Story, B.A.Sc., '15, is with the McCormick Mfg. Co. Ltd., London, as electrician. Address 579 Colborne St., London, Ont.

H. V. Serson, '05. Address, Box 107, Arnprior, Ont.

W. Snaith, '07, is with the Thor Iron Works Ltd., Toronto.

P. H. Stock, '09. Address 12 Fernwood Park Ave., Toronto.

K. E. Shaw, B.A.Sc., '13, is with the Dominion Sugar Co. Ltd., of Wallaceburg, preparing plans and estimates for a proposed 1,200 ton sugar beet factory to be erected at Chatham.

P. M. Sander, '04, is chief hydrographer in the Irrigation Branch of Department of Interior at Calgary. Address P.O. Drawer 2318, Calgary.

R. O. Standing, B.A.Sc., '14, is with Goldie & McCullough Ltd., Galt. His address, 40 West Main St. North, Galt.

M. L. Smith, B.A.Sc., '11, formerly associate editor for MacLean Publishing Co., Toronto, has accepted the position in charge of engineering at the New Technical School, Toronto.

W. H. Stevenson, B.A.Sc., '01, is secretary of the Power Plant Specialty Co., Monadnock Block, Chicago.

C. P. Sills, B.A.Sc., '11, is now at Seaforth, Ont.

E. H. Scott, B.A.Sc., '15, is guiding tourists throughout northern Ontario for the summer.

R. G. Scott, B.A.Sc., '15, is on geological survey work around Revelstoke.

J. B. Stitt, B.A.Sc., '15, is with the Braden Copper Co., Rancagua, Chile, South America.

J. E. C. Stroud, B.A.Sc., '15, is assistant chemist on smelter at Anyox, B.C.

H. W. Tye, '08, is now at Balcarres, Sask.

W. V. Taylor, '93, is principal assistant engineer to the Quebec Harbour Commissioners.

T. L. Villeneuve, '08, is with the Department of Public Works, Chicoutimi, Que.

O. T. G. Williamson, B.A.Sc., '09, resides at 1345 North Shore Ave., Chicago, Ill.

F. H. Wrong, '11, resides at 355 Bedford St., Sandwich, Ont.

J. A. Whelihan, '03, is ranching somewhere in the west. Try Box 165, Regina, Sask.

H. A. Wood, B.A.Sc., '15, is in charge of surveys for the Eastern Division of Toronto Harbour.

DIRECTORY OF THE ALUMNI

Gibson, M. M., '10, and **Gibson, W. S.,** '04, are members of the firm Gibson & Gibson, civil engineers and surveyors, Toronto.

Gibson, N. R., '01, 550 Confederation Life Building, Toronto.

Gillespie, P., '03, is associate Professor, Department of Applied Mechanics, University of Toronto.

Gillies, A., '07, is with the C.N.O. Ry. at Quebec, Que.

Glover, A. E., '09, is engaged in surveying in Edmonton, Alta.

Goad, V. A. E., '10, is a partner in the firm of the Chas. E. Goad Co., surveyors and civil engineers. He was in charge of their Montreal office when last heard from.

Goldie, A. R., '93, is a member of the firm of Goldie & McCulloch Co., Limited, Galt, Ont., as manager.

(*Continued on page x*)